Rotors in Complex Inflow, AVATAR, WP2

Sørensen, Niels N.

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AdVanced Aerodynamic Tools for lArge Rotors

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Rotors in Complex Inflow, AVATAR, WP2

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The Complex flow cases

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Setting/CASE	1	2	3	4	9
Tip Pitch [degrees]	0	0	0	0	0
Temperature [Celsius]	15	15	15	15	15
Pressure [hPa]	1013	1013	1013	1013	1013
Density [kg/m^3]	1.225	1.225	1.225	1.225	1.225
Viscosity [10^{-5} kg/ms]	1.7879	1.7879	1.7879	1.7879	1.7879
Wind Speed [m/s]	10.5	10.5	10.5	10.5	10.5
RPM	9.02	9.02	9.02	9.02	9.02
Yaw angle [degrees]	0.0	30	0.0	0.0	0.0
Shear Exponent	0.0	0.2	0.0	0.0	0.0
Wake Situation	None	None	None	Half Wake	None
Hub Height [m]	132.7	132.7	132.7	132.7	132.7

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Pitch Step

- To test the dynamic inflow models a dynamic pitch step were added (Case-9)
- The case is based on Case-1
  - For T < 90 sec. run at original conditions
  - At T = 90 sec. the turbine is pitched 2 degrees towards low AOA.
  - At T = 130 sec. the turbine is pitched 2 degrees toward higher AOA.
  - At T = 170 sec. the turbine is pitched 2 degrees toward higher AOA.
- To accommodate the CFD solvers the pitch is smoothed using a tanh function

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Torque and Thrust

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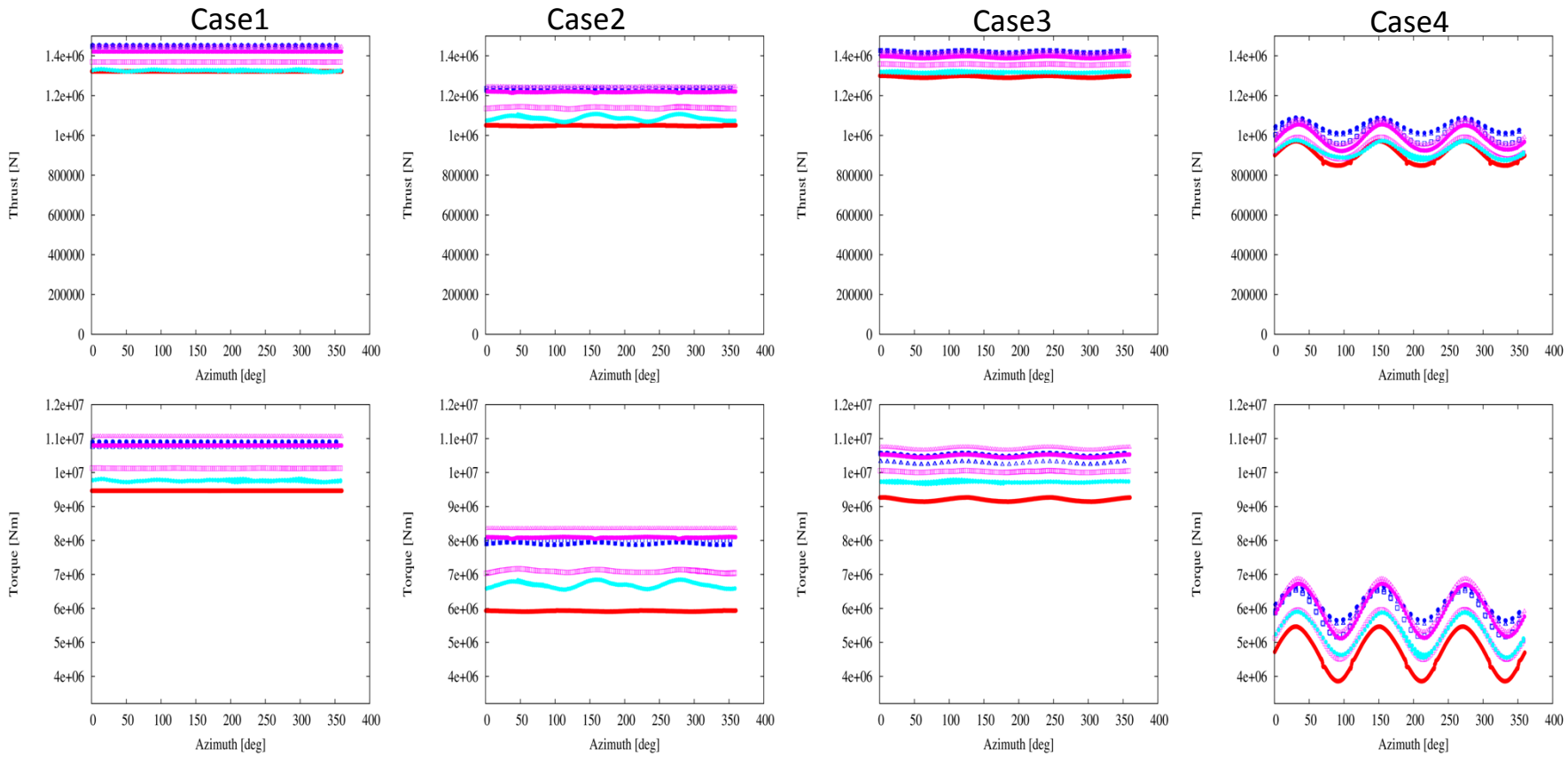

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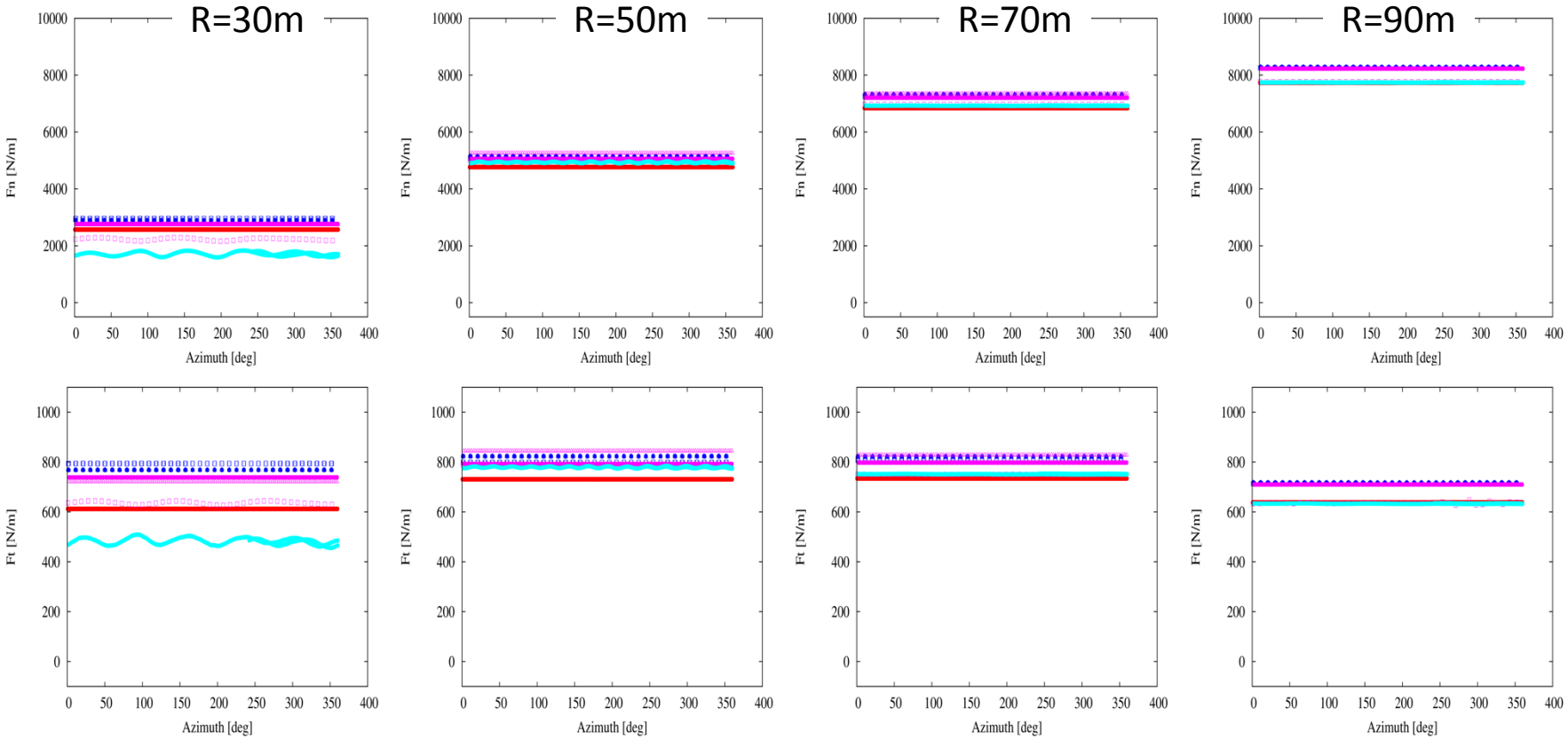
CASE-1 Axial Flow



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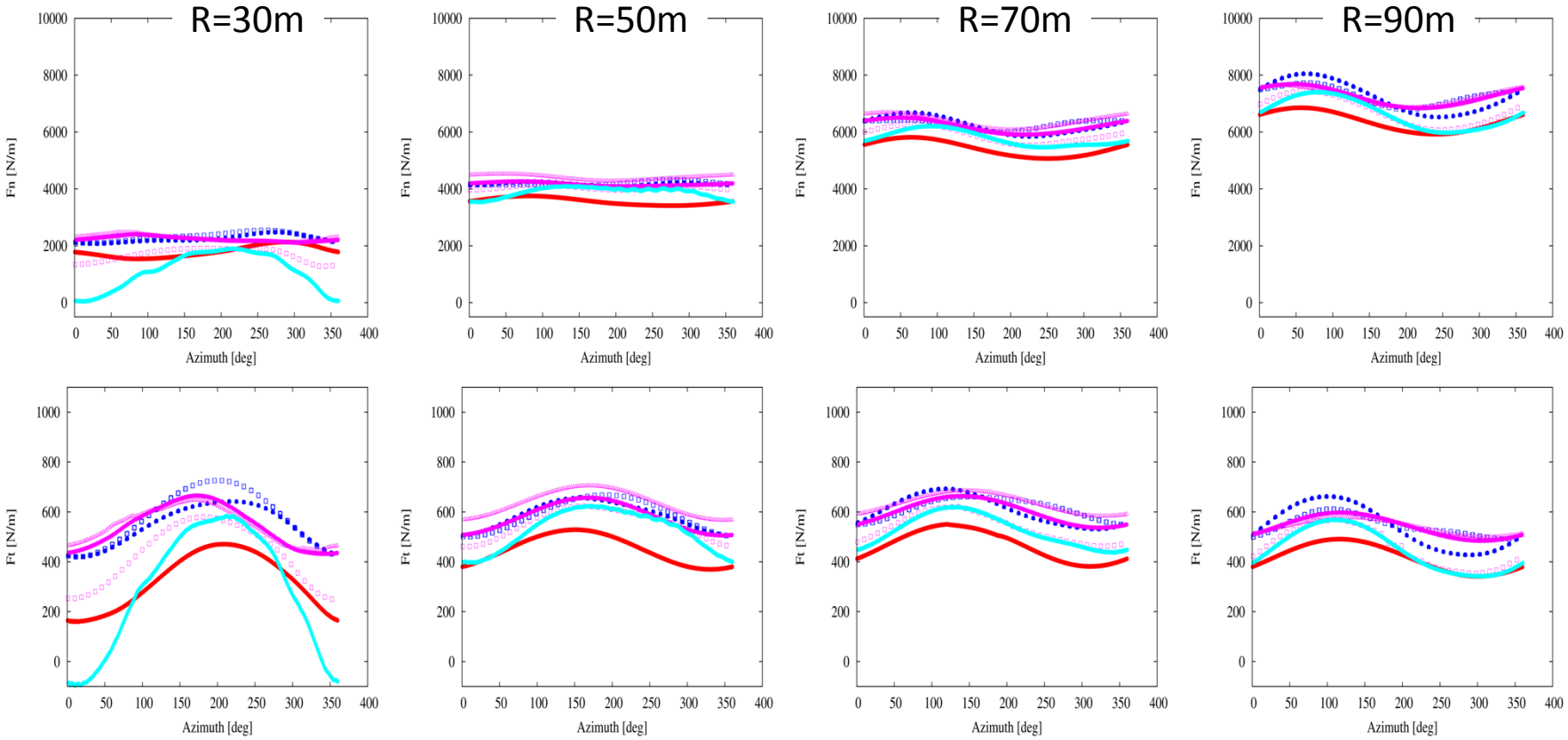
CASE-2 YAW



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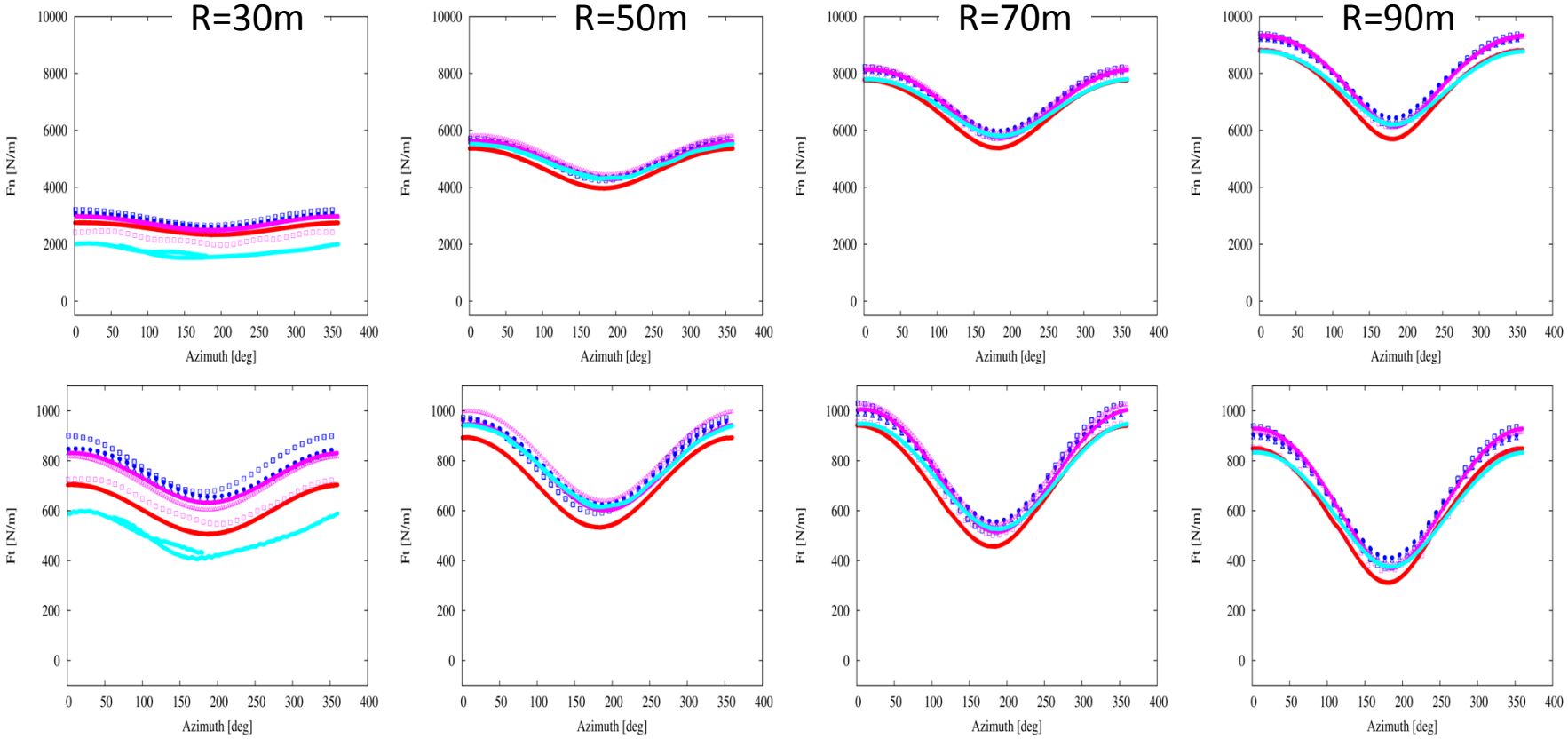
CASE-3 Shear



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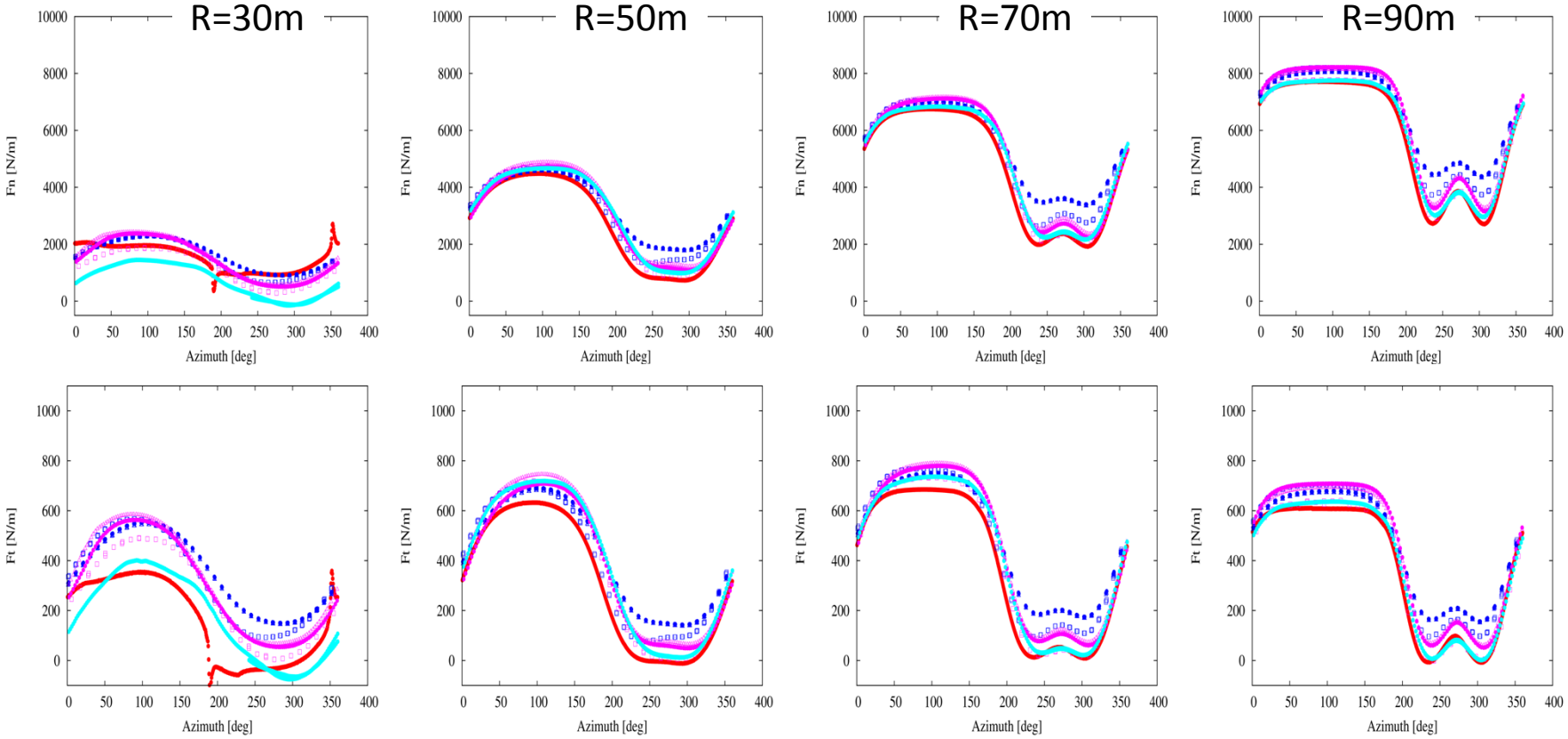
CASE-4 Half Wake



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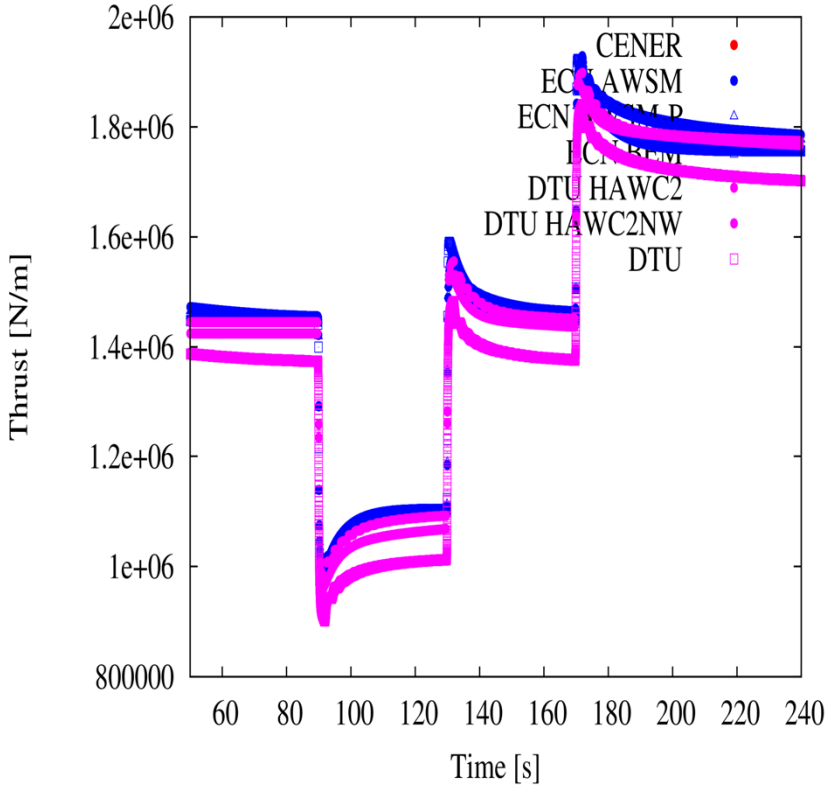
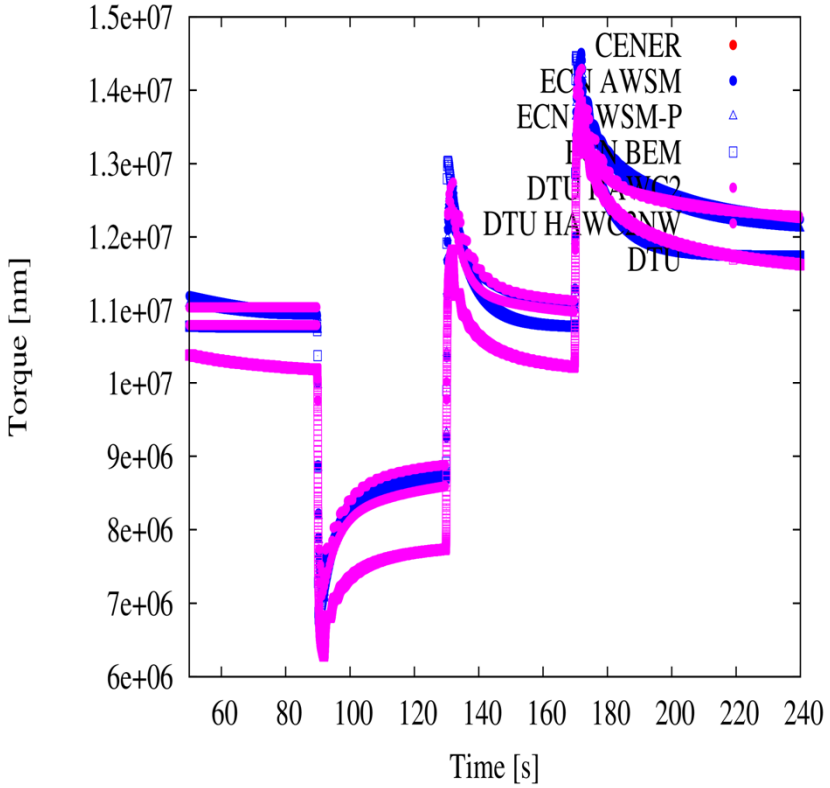
CASE-4 Pitch Step





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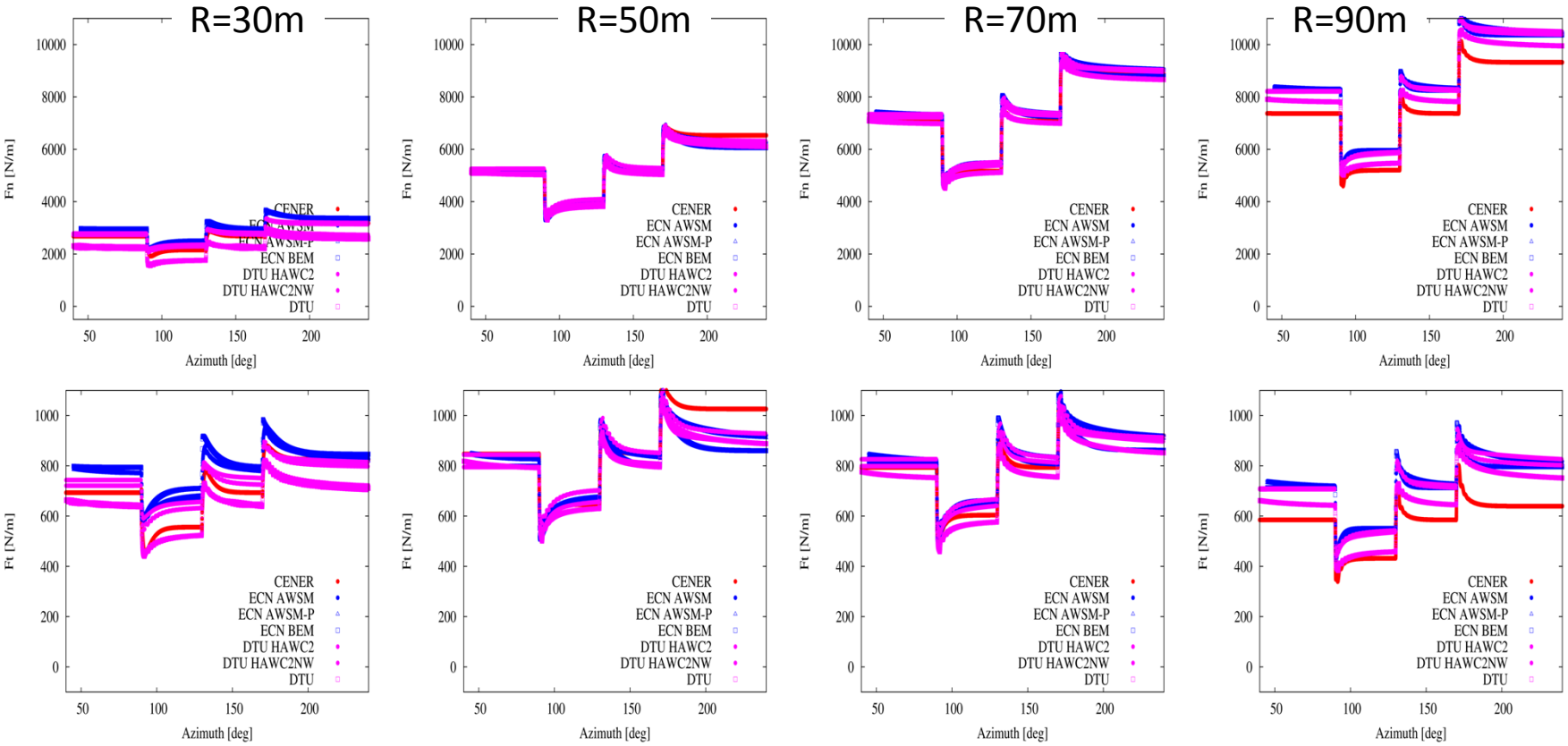
CASE-9 Pitch Step



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Highlights from the eng. model improvements

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- Airfoil data, 360 degrees, VG's and flaps, and compressible effects have been investigated
- New methods for AoA determination also in dynamic situations have been developed
- Tip loss model implementation
- The comparison with HPC simulations have revealed that e.g. the yaw cases are difficult for the eng. models
- Global versus local induction modeling
- Vortex models are a intermediate level that can be used to guide the development of eng. models

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DTU

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Thank you for your attention

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